Center Innovation Fund: MSFC CIF

Correlated Electromagnetic Levitation Actuator

Completed Technology Project (2015 - 2016)

Project Introduction

Approach is to first characterize the capabilities of correlated electromagnets by developing a prototype with readily available materials and manufacturing techniques. Then expand that capability by building two more prototypes that demonstrate specific controllable behavior. To show that this technology is feasible for applications described under the Goal Being Addressed, demonstrate that one correlated electromagnet can be levitated above another correlated electromagnet at various controllable heights and then rotated at that levitation height. This will demonstrate that the change in levitation height and rotation can be actuated through controlling the individual dipoles of the correlated electromagnets.

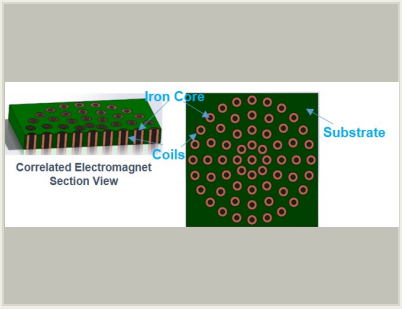
Anticipated Benefits

Seek to prove that correlated electromagnets can improve reliability of space systems and work for revolutionary applications such as autonomous docking of spacecraft without relying on thrusters, or separating stages of a launch vehicle without pyrotechnics.

This technology development aligns with many of NASA's and Marshall's Strategic goals as it can be used in many different applications. It specifically aligns with the following Marshall goals:

1. In-Space Propulsion with Emphasis on Electric Propulsion
2. Affordable, Innovative Transportation Architectures and Technologies for Low Earth (LEO) Delivery of Small Payloads
3. Small, Affordable ISS Payloads
4. Technologies for Space Situational Awareness and Space Object Interactions
5. Small Spacecraft and Enabling Technologies

In addition to being able to actuate reaction wheels without ball bearings, this technology will allow us to enable the following technologies: non-pyrotechnic separation systems that have few to no moving mechanical parts, autonomous docking and rendezvous, more efficient ion propulsion, LEO cubesats launched from ISS, aides for astronauts assembling components/structures, self-assembling components (including proximity operations for satellites), frictionless transmission with re-programmable gear ratios, multiple degrees of freedom (MDOF) actuator (such as reaction wheel control), non-mechanical thrust vectoring (thrust vector control (TVC)), non-pyrotechnic cubesat deployment mechanisms, chip-scale and small-scale accelerators, and many more.



Correlated Electromagnet Technology

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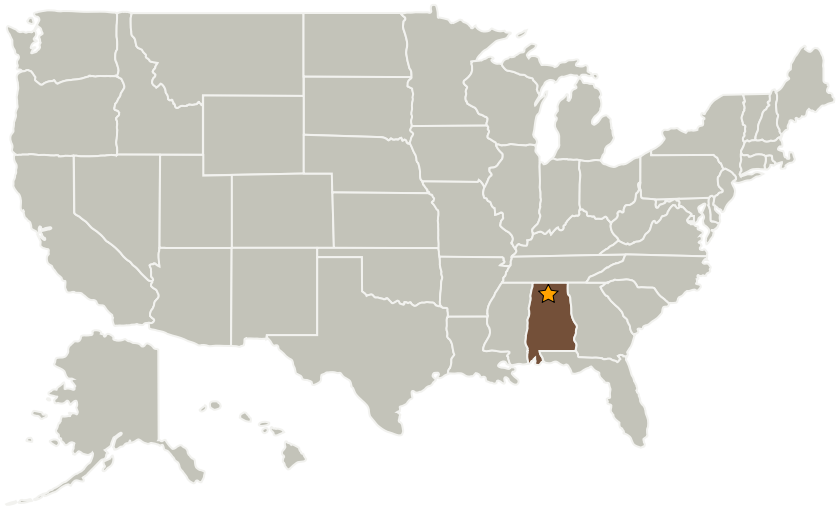
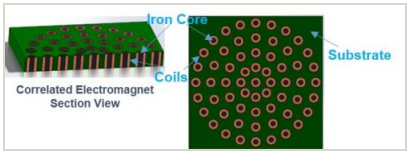
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Marshall Space Flight Center(MSFC)	Lead Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations
Alabama

Images



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(https://techport.nasa.gov/image/13346)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Center / Facility:
Marshall Space Flight Center (MSFC)

Responsible Program:
Center Innovation Fund: MSFC CIF

Project Management

Program Director:
Michael R Lapointe

Program Manager:
John W Dankanich

Principal Investigator:
Sarah A Triana

Co-Investigators:
Zenia A Garcia
Steven R Peeples
Pedro A Capo-Iugo
Paul T Britton
Kurt A Polzin

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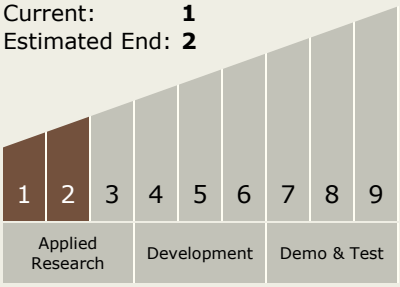
Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html

Technology Maturity (TRL)

Start: **1**
Current: **1**
Estimated End: **2**



Technology Areas

Primary:

- TX17 Guidance, Navigation, and Control (GN&C)
  - TX17.3 Control Technologies
    - TX17.3.4 Control Force/Torque Actuators